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UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

SOIL SURVEY REPORT

of the

UPPER SLIDE LAKE S&W PROJECT

TETON NATIONAL FOREST, R-4, WYOMING

by

O. C. Olson, Soil Scientist

March 1961

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U. S. GOVERNMENT PRINTING OFFICE

16—73806-1

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INTRODUCTION

The soils photo-map and its legend are presented in the first part of this report and is followed by a characterization of the soils. This descriptive material includes for each soil mapping unit information about the soil horizons and the associated topography (landforms) and vegetation. The general pattern of soil erosion that has developed on each soil unit is also briefly noted. Reference is made to such forms of soil destruction as sheet wash and gullying, slumps and other mass movements, and channel cutting. Such information, of course, does not permit a comprehensive evaluation of erosion in terms of specific causes, chronology of erosion events, or even reliable estimates of rates or quantities of soil lost. More studies on this and on adjacent areas would be necessary before such an analysis would be possible. The major value of these general observations, however, is that attention is focused on the fact that particular kinds of soils have particular kinds of erosional problems or hazards. Successful and economical treatment of unstable soils and soil surfaces require a consideration of both the nature of the problem and the characteristics and potential of the existing soil resource.

The second major portion of the report contains interpretations regarding the productive potentials and some of the inherent erosion hazard factors. These appraisals are based on judgment and experience and should be considered on that basis only.

The final portion presents some laboratory data on a few selected soil samples together with a recommended treatment for trial fertilizer applications.

SOILS MAP
UPPER SLIDE LAKE
S & W PROJECT
Scale: 1" = 833'

MAP LEGEND

Soil Mapping Unit No.	Name of Soil Mapping Unit	Extent	
		Acres	%
1.	Very shallow, moderately fine textured soils	73	26.1
2.	Shallow to moderately deep, moderately fine textured soils	7	2.6
3.	Very deep, moderately fine textured soils	15	5.3
4.	Very deep, moderately fine textured soils with strongly developed subsoils	17	6.1
5.	Very deep, medium textured soils with strongly developed subsoils	13	4.7
6.	Very shallow, moderately coarse textured soils	37	13.1
7.	Very deep, moderately coarse textured soils with weakly developed subsoils	6	2.1
8.	Deep to very deep, medium textured soils with weakly developed subsoils	19	6.9
10.	Deep, coarse textured soils with moderately well developed subsoils	6	2.2
11.	Very deep, coarse textured soils with moderately well developed subsoils	3	1.0
12.	Undifferentiated alluvial soils	37	13.5
13.	Undifferentiated residual and slumped soils	26	9.1
14.	Shallow, very gravelly cobbly soils	4	1.3
3-1	Complex of soil units 3 and 1	2	.8
9-5	Undifferentiated unit of soil unit No. 9, (moderately deep, medium textured soils with moderately well developed subsoils) and soil unit No. 5.	15	5.2
	Total	280	100.0

CHARACTERIZATION OF THE SOIL MAPPING UNITS

Soil Mapping Unit No. 1: Very shallow, moderately fine textured soils derived from shales.

Associated landform characteristics: Uneven cut-slopes of the dipping rock formation; includes some rounded ridgetops. Slope gradients typically vary from 30-70%.

Vegetation: Sparse forb-grass type with scattered sagebrush.

Profile characteristics:

Surface horizon - Light brownish gray, gravelly (shaly) silty clay loam; granular structure except massive in the first 1/2"; dry hard, moist friable to firm; strongly calcareous. About 4" to 6" thick.

Subsurface horizon - Similar to surface horizon but lighter colored and more shaly. Frequently absent or very thin.

Substratum - Weathered shale occurring at depths varying from 4" to 14"; slowly permeable, penetrated by a few roots. Locally includes some interbedded sandstone layers.

Erosion conditions: Severely eroded; subjected to intense sheet washing and gullying. Most of the gullies appear to have originated from on-site runoff but the larger gullies on this soil unit in the East Fork drainage area have been considerably enlarged through head-cutting action initiated from below.

Remarks: Some conifer stumps are present on the areas mapped. Those in place appear to be oriented either along a gully or horizontally across the slope on some of the exposed, interbedded sandstone members of the shale formation. It seems unlikely that conifers were ever extensive on this soil unit.

Soil Mapping Unit No. 2: Shallow to moderately deep, moderately fine textured soils, derived from shales.

Associated landform characteristics: Slightly concave slopes in the heads of drainageways and on toe slopes. Slope gradients vary from 20 to 55%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Light brownish gray silty clay loam; granular structure except massive in the first $\frac{1}{2}$"; dry hard, moist friable to firm; strongly calcareous. About 2" to 6" thick.

Subsoil horizon - Light gray heavy silty clay loam; moderate, medium blocky structure; dry hard, moist firm; strongly calcareous. About 15" to 25" thick.

Substratum - Weathered shale and/or fine grained sandstone occurring at depths varying from 20" to 30".

Erosion conditions: Severely eroded; subjected to intense sheet washing. Local accumulations of materials occur on this soil unit that have been washed and/or slumped from areas above.

Remarks: This unit is transitional in character between unit No. 1 and units No. 3 and 4.

Soil Mapping Unit No. 3: Very deep, moderately fine textured soils derived from shale.

Associated landform characteristics: Smooth side slopes.

Vegetation: Forb-grass and sagebrush-forb-grass types.

Profile characteristics:

Surface horizon - Light brownish gray silty clay loam; granular structure except massive in the first $\frac{1}{2}$"; dry hard, moist friable to firm; strongly calcareous. About 2" to 6" thick.

Subsurface horizon - Light brownish gray silty clay loam heavily flecked with limy material; very weak, coarse blocky structure; dry hard, moist friable to firm; strongly calcareous. Generally becomes gravelly silty clay loam below 30".

Substratum - Not observed but weathered shale and sandstone are presumed to occur at depths greater than 60".

Remarks: This soil unit may at one time have been somewhat more extensive in the East Fork drainage area.

Soil Mapping Unit No. 4: Very deep, moderately fine textured soils with strongly developed subsoils, derived from shaly material.

Associated landform characteristics: Alluvial-colluvial fans and toe slopes. Slope gradients vary from 10 to 45%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Gray brown silty clay loam; moderate granular structure; dry hard, moist friable; strongly calcareous. About 8" thick.

Subsurface horizon - Light brownish gray silty clay loam; weak, medium blocky structure; dry hard, moist firm; strongly calcareous. About 16" thick.

Subsoil horizon - Light brownish gray clay; moderate, medium blocky structure; moist very firm; flecked with lime. At least 30" thick.

Substratum - Not observed but weathered shales and sandstone are presumed to occur at considerable depths - likely more than 10'.

Erosion conditions: Slightly to moderately eroded in general plus deeply gullied in the East Fork drainage area. Locally contains accumultions of materials washed and/or slumped from areas above.

Remarks: Grades into unit No. 12 on the lower edge and the dividing line between these two soil units is not clear-cut.

Soil Mapping Unit No. 5: Very deep, medium textured soils with strongly developed subsoils, derived from shales.

Associated landform characteristics: Concave slopes in the heads of drainage-ways and stringers immediately below the crests of spur ridges. Slope gradients vary from 35% to 65%.

Vegetation: Remnant aspen and/or Douglas fir types. Dominant cover at present over much of this unit is a mixed brush-forb-grass type.

Profile characteristics:

Surface horizon - Dark gray brown silt loam; moderate, fine granular structure; dry slightly hard, moist friable; calcareous. About 15" thick.

Subsurface horizon - Light brownish gray silty clay loam; moist firm; moderate, medium blocky structure; calcareous. About 5" to 15" thick.

Subsoil horizon - Gray brown to olive gray clay; strong, medium blocky structure; moist very firm; strongly calcareous. At least 25" thick.

Erosion conditions: Subjected to localized slumping. Sheet erosion generally restricted to the slumped areas.

Remarks: In all probability, this soil unit developed under a stand of aspen, with or without some conifer. Note the thick, dark colored surface horizon which is typical of this kind of development.

Soil Mapping Unit No. 6: Very shallow, moderately coarse textured soils, derived from sandstones.

Associated landform characteristics: Uneven cut-slopes of the dipping rock formations, including some rounded ridges. Slope gradients vary from 30 to 70%.

Vegetation: Sparse forb-grass type with scattered sagebrush.

Profile characteristics:

Surface horizon - Light gray fine sandy loam; granular structure except

massive in the first 1"; dry hard, moist friable; strongly calcareous. About 4" to 6" thick.

Subsurface horizon - Similar to surface layer but becomes gravelly. Frequently this horizon is absent or very thin.

Substratum - Well weathered calcareous sandstone occurring at depths varying from 4" to 14".

Erosion conditions: Severely eroded; subjected to intense sheet washing and gullying.

Remarks: This soil unit is the sandstone counterpart of unit No. 1.

Soil Mapping Unit No. 7: Very deep, moderately coarse textured soils with weakly developed subsoils, derived from sandstone.

Associated landform characteristics: Slightly concave slopes in the heads of drainageways and on side slopes. Slope gradients vary from 30 to 45%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Gray brown fine sandy loam; weak, medium subangular blocky structure; dry soft to slightly hard, moist friable; generally calcareous. About 5" thick.

Subsurface horizon - Similar to surface horizon except lighter color. About 24" thick.

Subsoil horizon - Pale brown loam to heavy loam; weak, medium subangular blocky structure; dry slightly hard, moist firm; strongly calcareous. At least 30" thick.

Substratum - not observed but weathered sandstone is presumed to occur at depths greater than 60".

Erosion conditions: Slightly eroded by sheet wash. Local accumulations occur but the unit is not gullied.

Remarks: Closely related to soil unit No. 8. The surfaces of unit No. 7 are less calcareous and darker in color, and the overall depth of the soil mantle is believed to be somewhat deeper than that of unit No. 8.

Soil Mapping Unit No. 8: Deep to very deep, medium textured soils with weakly developed subsoils, derived from sandstone materials.

Associated landform characteristics: Toe slope and basin-like positions. Slope gradients vary from 10 to 35%.

Vegetation: Forb-grass type with varying amounts of sagebrush.

Profile characteristics:

Surface horizon - Light brownish gray fine sandy clay loam (marginal to fine sandy loam); weak subangular blocky structure except massive in the first 1"; dry hard, moist friable; strongly calcareous. About 12" to 24" thick.

Subsurface horizon - Light brownish gray to pale brown fine sandy loam (marginal to fine sandy clay loam); weak, medium subangular blocky structure; dry hard, moist firm; strongly calcareous. About 40" to 50" thick.

Substratum - Weathered sandstone or shale occurring at depths greater than 50".

Erosion conditions: Moderately to severely eroded; subjected to considerable sheet wash and gullying.

Remarks: See remarks for unit No. 7.

Soil Mapping Unit No. 9: Moderately deep, medium textured soils with moderately well developed subsoils, derived from sandstones.

Associated landform characteristics: Smooth side slopes. Slope gradients varying from 25 to 40%.

Vegetation: Sagebrush-forb-grass with some scattered aspen remnants.

Profile characteristics:

Surface horizon - Dark gray brown loam; moderate, fine granular structure; dry slightly hard, moist very friable; non - to weakly calcareous. About 10" to 20" thick.

Subsoil horizon - Gray brown fine sandy clay loam; weak, medium subangular blocky structure; dry hard, moist friable; non - to weakly calcareous. About 10" to 15" thick.

Substratum - Weathered sandstone bedrock occurring at depths varying between 20" to about 36".

Erosion conditions: Slightly eroded by sheet wash; no gullying.

Remarks: It is believed that this soil also developed under aspen. This is indicated by the dark color and thickness of the surface horizon, and minor other differences that are usually associated with such development. This unit has not been differentiated on the map from unit No. 5 with which it occurs intimately associated.

Soil Mapping Unit No. 10: Deep, coarse textured soils with moderately well developed subsoils, derived from sandstones.

Associated landform characteristics: Slightly concave end facet of a truncated spur ridge. Also occurs on a ridge top. Slope gradient

generally vary between 50 to 60%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Gray brown loamy fine sand; weak, medium granular structure; dry slightly hard, moist very friable; moderately calcareous. About 6" to 10" thick.

Subsurface horizon - Similar to surface soil except color is lighter and the structure is very weak subangular blocky. About 14" thick.

Subsoil horizon - Light brownish gray fine sandy loam with lenses of loamy fine sand; weak subangular blocky structure; moderately to strongly calcareous. At least 20" thick.

Substratum - Weathered sandstone bedrock at depths varying from 36" to 50".

Erosion conditions: Moderately eroded by sheet wash and, likely, some wind erosion.

Remarks: Closely related to soil unit No. 11; differs mainly in depth.

Soil Mapping Unit No. 11: Very deep, coarse textured soils with moderately well developed subsoils, derived from sandstones.

Associated landform characteristics: Concave slopes immediately below and parallel to the ridge tops (snow cornice position). Slope gradients vary from 50 to 70%.

Vegetation: Mountain brush type.

Profile characteristics:

Surface horizon - Gray brown loamy fine sand; weak, granular structure; dry slightly hard, moist very friable; moderately calcareous. About 8" to 12" thick.

Subsurface horizon - Similar to surface soil except lighter color and structure is very weak subangular blocky. About 20" to 40" thick.

Subsoil horizon - Light brownish gray fine sandy loam with lenses of loamy fine sand; very weak subangular blocky structure; dry slightly hard, moist very friable; moderately calcareous.

Substratum - Weathered sandstone presumably occurs at depths greater than 60".

Erosion conditions: Little or no erosion observed on this soil unit.

Remarks: See remarks for unit No. 10.

Soil Mapping Unit No. 12: Undifferentiated alluvial soils.

Associated landform characteristics: Terrace and bottomlands. Slope gradients vary from 2 to 10%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Gray brown loam; weak subangular blocky structure; dry hard, moist friable; strongly calcareous. About 6" to 10" thick.

Subsurface horizon - Light brownish gray fine sandy loam; weak subangular blocky structure; moist friable; strongly calcareous. About 16" thick.

Subsoil horizon - Gray brown silty clay loam; weak subangular blocky structure; dry hard, moist firm; strongly calcareous. At least 20" thick.

Substratum - Alternating horizons of variable textured materials - loamy sands to clays. Many feet to bedrock.

Erosion conditions: Slightly to moderately eroded in places; many small areas receiving accumulations. Channel cutting active throughout the East Fork drainage, locally in the West Fork.

Remarks: The subsoil horizon is actually a buried soil. This kind of a profile is common in this soil unit but several other variations also occur.

Soil Mapping Unit No. 13: Undifferentiated residual and slumped soils.

Associated landform characteristics: Smooth to uneven slopes on the dip-side of the shale formations. Slope gradients vary from 20 to 70%.

Vegetation: Dominantly sagebrush-forb-grass type.

Profile characteristics:

The pattern of soils is too complex to delineate separately on the map scale used. The undifferentiated unit includes soils similar to soil units 1, 2, and 5 plus unclassified soils on the numerous slumps and slump scarps.

Erosion conditions: Subjected to considerable slumping and minor land flows; slightly to severely eroded by subsequent sheet wash. Accumulations numerous.

Remarks: These high hazard-slumped areas are exceedingly poor risks for engineering structures of any kind - roads, trenches, barriers, etc.

Soil Mapping Unit No. 14: Shallow, very gravelly cobbly soils, derived from conglomerates.

Associated landform characteristics: Convex slopes on narrow ridge tops. Slope gradients vary from 0-20%.

Vegetation: Sagebrush-forb-grass type.

Profile characteristics:

Surface horizon - Dark reddish brown very gravelly, cobbly sandy loams. About 2" to 6" thick.

Subsurface horizon - Similar to surface soil except lighter colored and somewhat coarser textured.

Substratum - Conglomerate bedrock at depths varying from 6" to 18".

Erosion conditions: Slightly to moderately eroded by sheet wash and wind erosion.

Remarks: Very inextensive on this study area.

Soil Mapping Unit No. 3-1:

This is a soil complex composed of soil units No. 3 (about 2/3 of the total unit area) and No. 1 (about 1/3 of the total unit area). See soil units No. 3 and 1 for information pertaining to the individual soils.

Soil Mapping Unit No. 9-5:

This is an undifferentiated unit (pattern of soils is unknown and unpredictable at the present time) composed of soil units No. 9 (at least $\frac{1}{2}$ of the total unit area - possibly somewhat more) and No. 5 (perhaps less than $\frac{1}{2}$ of the total unit area). See soil units No. 9 and 5 for information pertaining to the individual soils.

INTERPRETATIONS

Estimated Productivity Potentials

In this report productivity potential refers the estimated capacity of a given soil to produce specified plants under an extensive level of management. The ratings for each soil in this area is based on an appraisal of the soil profile characteristics. The background for the appraisals have been obtained from observed or measured soil-plant relationships throughout the Intermountain Region.

Ratings for aspen and Douglas fir are as follows:

Unsuited - This rating is given to those soils that have definitely unfavorable soil characteristics for these species and whose profiles show no evidence of ever having developed under their influence. Does not preclude the possibility, however, of individual trees becoming established in gullies or on other more favorable site situations.

Questionable - This rating is given to two soils whose profiles do not definitely indicate that they developed under an aspen or conifer cover but at the same time appear to have the general soil characteristics that elsewhere in the region have produced stands of these species.

Poor and Fair - These ratings are used for those soils that have developed under aspen or conifer and are rated in a relative order according to the quality of the profiles (for these species). In general, the highly calcareous nature of these soils plus the dense character of the subsoils (unit No. 5) and the relatively shallow depths to bedrock (unit No. 9) are probably the primary limiting soil factors for timber production in this area.

The estimated productivity potentials for native herbaceous plants are in a general way based on the field estimates of the available moisture holding capacity of the individual soils. For example, soil unit No. 1 is 6" to 10" thick on the average and is underlain by shale bedrock. The moisture holding capacity of this soil is extremely limited. Its fertility levels of nitrogen and phosphate are very low (based on laboratory determination). The capacity of this soil for growing herbaceous plants is the poorest in the area. On the other end of the scale, soil units No. 4 and 5 have thick, dark colored surfaces (indicating higher levels of nitrogen), subsoils having high moisture holding capacities, and are deep to bedrock. The capacity of these soils for growing herbaceous plants is appraised to be good or better. The other soils fall into rating classes somewhere between these extremes. Rating differences are, of course, relative only.

The estimated productivity potentials are shown in Table No. II.

Partial Erosion Hazard Appraisals

Soil erosion by water is believed to be a function of climate, soils, topography, and vegetation. Therefore, erosion hazard can be assumed to be a function of the climatic hazard, the soil erodibility hazard, the topographic hazard, and the resistance offered by vegetation and/or mechanical devices. This report will be concerned only with tentative appraisals of the soil erodibility hazards and the topographic hazards, the ones which can be directly related to the individual soil units of the area.

The soil erodibility hazard is based on (1) the stability of the surface soil and (2) the runoff potential of the soil profile. The field evaluation of these factors was based on the moist strength and size of the surface soil aggregates, the surface texture including amounts of coarse fragments, and profile permeability appraisals. The topographic hazard was appraised from the gradient and length of slopes as well as the micro-irregularities of the land form surfaces that are normally associated with each of the soil units.

The ratings based on field appraisals for each of the hazards, including the two components of soil erodibility, are shown on Table No. II. The ratings are based on five possible classes for each item.

As stated above, the ratings of the soil erodibility and topographic hazards do not completely nor necessarily directly reflect the overall erosion hazard. However, in an indirect sense the ratings are an indication of the probable arrangements of the actual erosion hazards of the soil units on the area.

Table II Selected Soil Interpretations

Soil Unit	Est. Productivity Potential		Partial Erosion Hazard Appraisals			
	Douglas Fir Aspen	Herbaceous	Susceptibility To Detachment	Runoff Potential Of The Profile	Soil Erodibility Hazard Rating	Topographic Hazard Rating
1	Unsuited	Very poor	Mod. High	High	High	High
2	Unsuited	Poor to fair	Mod. High	Mod. High	Mod. High	Mod. High
3	Unsuited	Fair	Mod. High	Mod. High	Mod. High	Mod. High
4	Question-able	Good to very good	Moderate	Mod. High	Mod. High	Moderate
5	Fair	Good to very good	Moderate	Moderate	Moderate	Mod. High
6	Unsuited	Very poor	Mod. High	Mod. High	Mod. High	High
7	Unsuited	Fair to good	Moderate	Moderate	Moderate	Moderate to Mod. High
8	Unsuited	Fair to good	Mod. High	Moderate	Moderate	Moderate to Mod. Low
9	Fair to poor	Good	Moderate	Moderate	Moderate	Mod. High
10	Unsuited	Fair	Mod. High	Mod. Low	Moderate	High
11	Question-able	Good	Mod. High	Low	Mod. Low	High
12	Unsuited	Good (±)	Mod. High	Moderate	Mod. High	Low
14	Unsuited	Very poor to poor	Mod. Low	Moderate	Mod. Low	Mod. Low

FERTILITY APPRAISALS

Laboratory Data

Soil No.	Depth	$Ca\ CO_3$ (Lime) %	P_2O_5 (Avail.) lbs./acre	K (Avail) PPM	N (Total) %
1	0-6"	10.5	10	121	.048
8	0-6"	12.7	16	140	.056
	32-60"	13.2	10	141	.060
8	0-6"	10.5	8	119	.052
	12-24"	10.3	6	130	.043

Treatments

Both the shale (1) and the sandstone (8) derived soils test very low in P_2O_5 and N. K appears adequate.

Recommended standard treatment: 60 lbs. N per acre
40 lbs. P_2O_5 per acre

It is also recommended that a treatment having twice standard rates (120 lbs. N per acre, 80 lbs. P_2O_5 per acre) be tried.

Fertilizers

60 lbs. N. = 132 lbs. ~~area~~ urea, or
180 lbs. ammonium nitrate, or
300 lbs. ammonium sulphate

40 lbs. P_2O_5 = 88 lbs. treble superphosphate, or
200 lbs. superphosphate

Because of its acidifying effects, the use of ammonium sulphate might provide dual benefits. It may reduce the excessively high concentrations of $CaCO_3$ as well as being a source of N.